NASA SBIR/STTR Technologies

H7.01-9025 - Embedded Multifunctional Optical Sensor System

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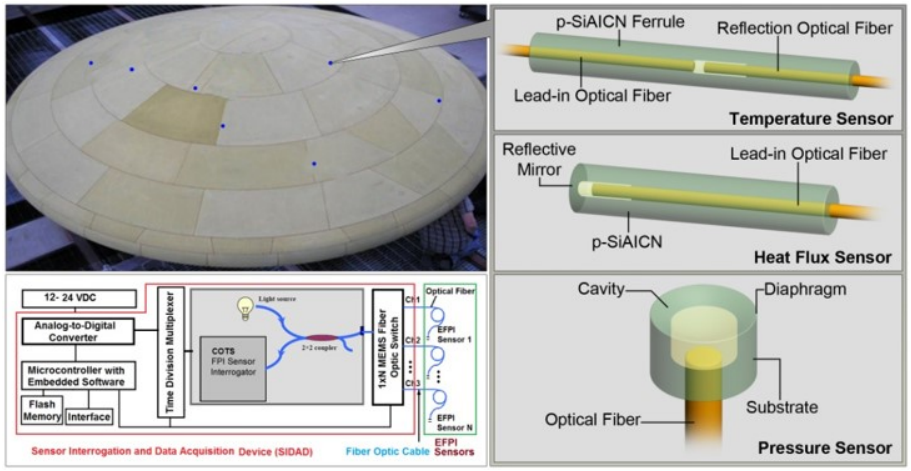
Identification and Significance of Innovation

To address NASA's need for in situ sensor systems for use on rigid and/or flexible ablative thermal protection system (TPS) materials, Physical Optics Corporation (POC) proposes to develop a novel Embedded Multifunctional Optical Sensor (EMOS) system providing accurate in situ measurement of multiple TPS structural, aerothermal, and aerodynamic response parameters including temperature, heat flux, and pressure. EMOS is based on further essential development, optimization, and improvement of the POC-developed fiber optic microsensor technology, which allows the measurement of multiple physical parameters (e.g., pressure, temperature, and heat flux) using a suite of miniature (diameter <400 m) fiber optic Fabry-Perot (FP) interferometric sensors. EMOS will support an operating temperature range up to 1500°C and measurement errors within 0.4% for temperature sensors, 0.2% for pressure sensors, and 20% for heat flux measurement.



Estimated TRL at beginning and end of contract: (Begin: 4 End: 6)

Technical Objectives and Work Plan

Technical Objectives: (1) Optimization of the overall EMOS system architecture; (2) Development and refinement of EMOS sensors; (3) Design and development of EMOS sensor interrogator; (4) Design and development of EMOS supporting software; (5) Assembly of EMOS sensors and overall EMOS Phase II prototype system; (6) Testing and evaluation of prototype EMOS system performance in a relevant and simulated environment; (7) Identification of the commercial potential and technology transition path of the EMOS technology.

Work Plan: (1) Refine the EMOS System Concept of Operations; (2) Optimize and Refine the EMOS System Architecture; (3) Design EMOS Structures; (4) Model and Simulate EMOS Performance; (5) Fabricate the EMOS Sensors; (6) Design EMOS Interrogation and Data Acquisition Device; (7) Develop and Test EMOS Interrogation and Data Acquisition Device; (8) Design and Develop Supporting Software for the EMOS System; (9) Design and Develop Mechanical Packaging for EMOS; (10) Package the EMOS Interrogation System; (11) Assemble the EMOS System and Test Its Functionality; (12) Design and Develop EMOS Test Setup; (13) Develop EMOS System Test Plan; (14) Test and Evaluate EMOS Performance; (15) Conduct System Demonstrations; (16) Investigate EMOS System Commercialization; (17) Prepare and Submit Reports.

NASA Applications

EMOS can be used for measurement of TPS response in aerothermal and aerodynamic environments, providing better traceability from the modeling and design tools to actual performance. EMOS microsensors can be applied to different types of ablative materials used for TPS, including but not limited to, PICA, PICA-X, SIRCA, Superlight Ablator (SLA), and Avcoat, and those under development for planetary aerocapture and entry as well as return to Earth.

Non-NASA Applications

Health monitoring of military aircraft components; health monitoring of commercial aircraft engines, drive-train systems, and utility systems; monitoring of coal-fired power plants, natural-gas-based power plants, geothermal plants, as well as other power-generation facilities throughout the nation.

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